PXIE RFQ end-walls

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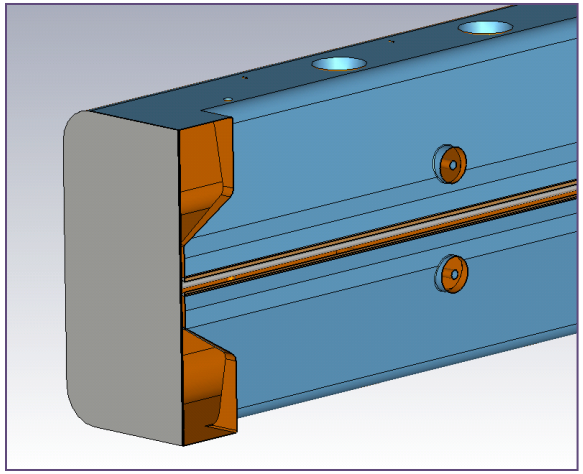
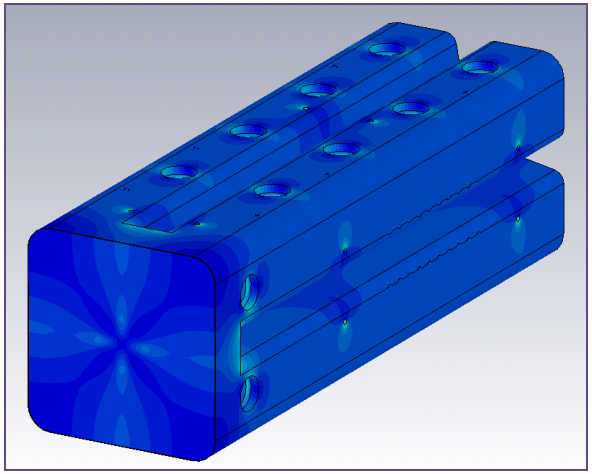
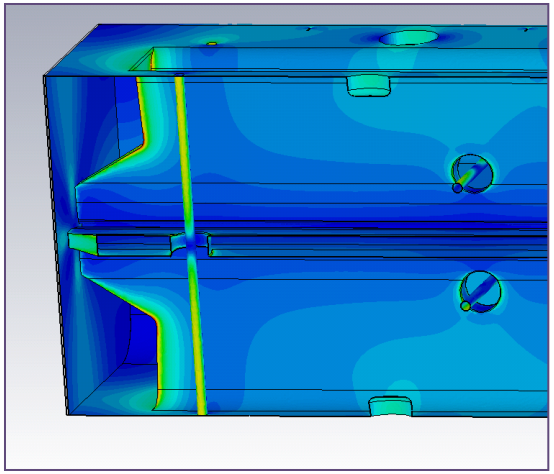
Heating of the end-walls



Copper plate end-wall in the RFQ RF model

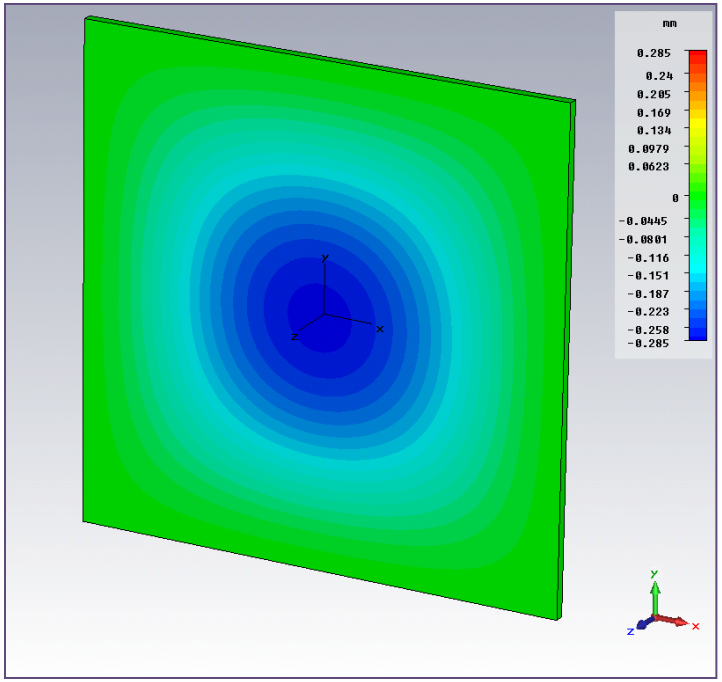




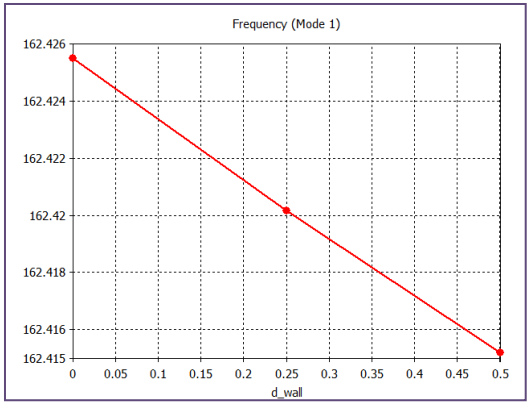
Density of the surface RF losses (logarithmic scale)

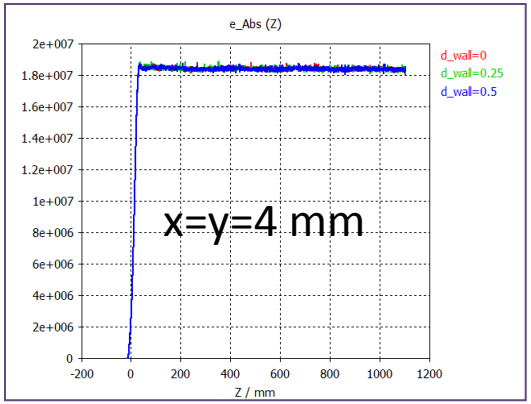
DC power losses (heat)
Input end-wall – 246 W
Output end-wall – 360 W

Deformation of the end-walls

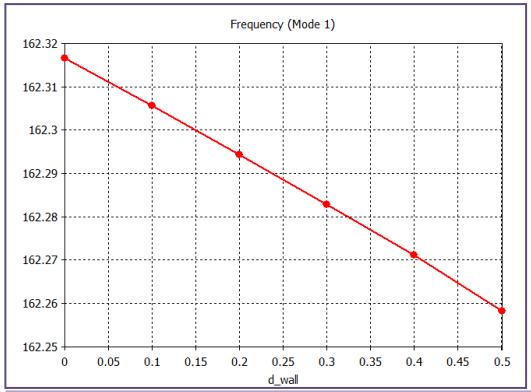


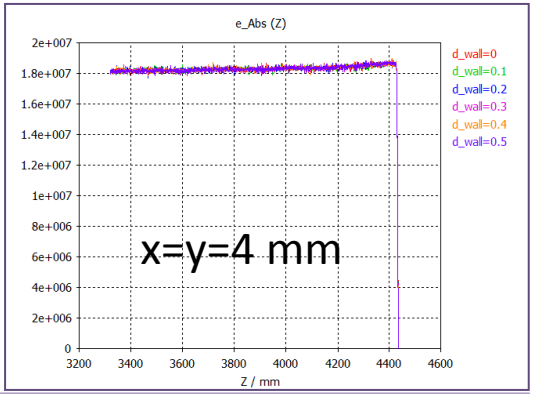
End-wall displacement due to atmospheric pressure.
Maximum displacement is 0.3 mm for end-wall enforced with steel plate 7 mm thick (see next slide)





Frequency and field distribution vs input end-wall displacement.

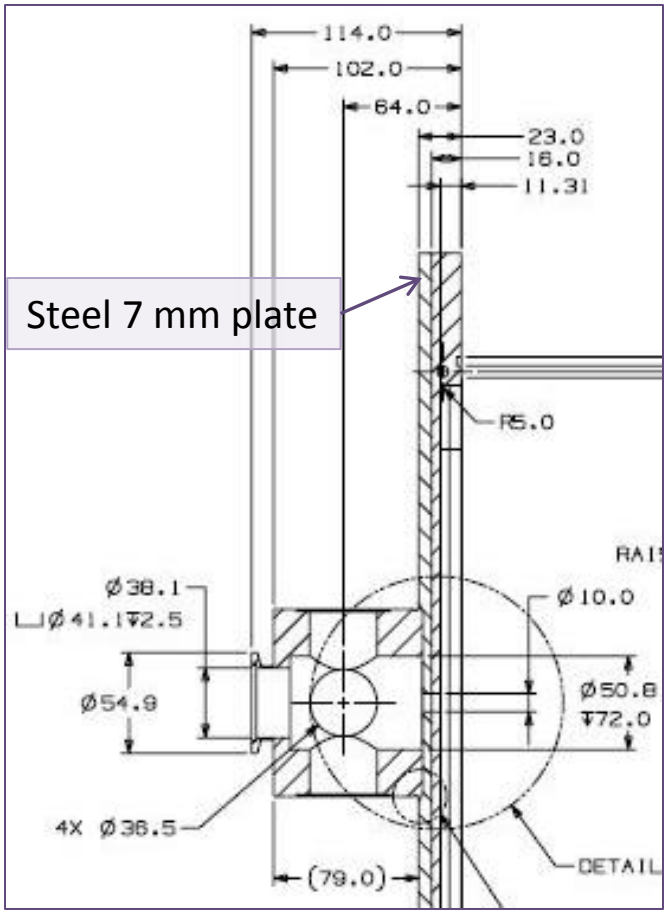


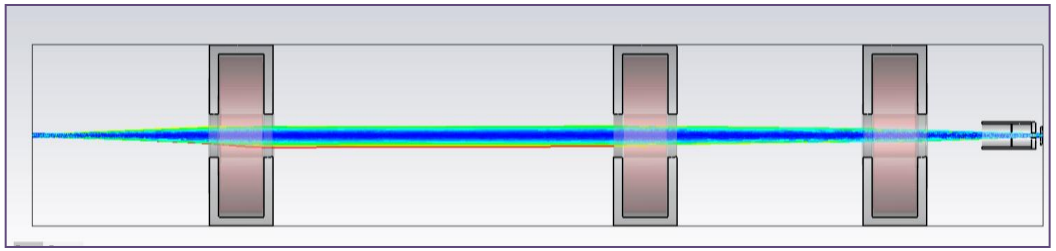


Frequency and field distribution vs output end-wall displacement.

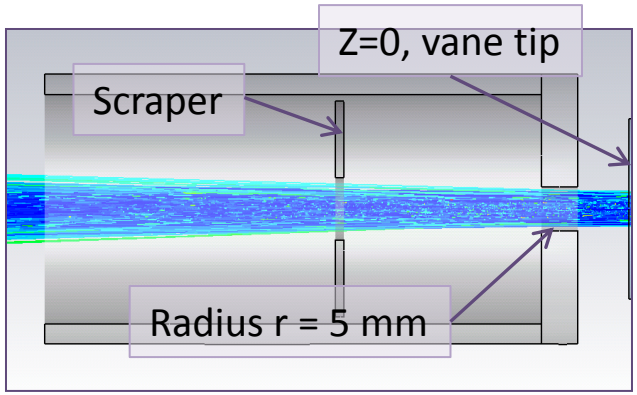
Steel plates 6-8 mm thick seems to be OK for end-plates enforcement .

Matched input beam

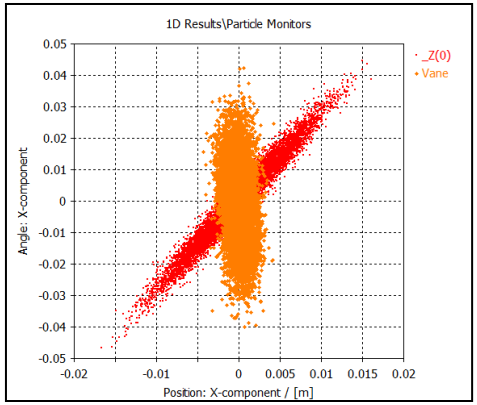




Beam in LEBT. CST PS simulations. “Smooth” variant.



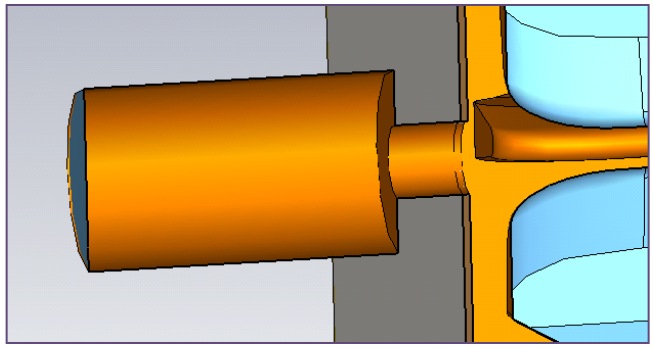
LEBT_RFQ interface



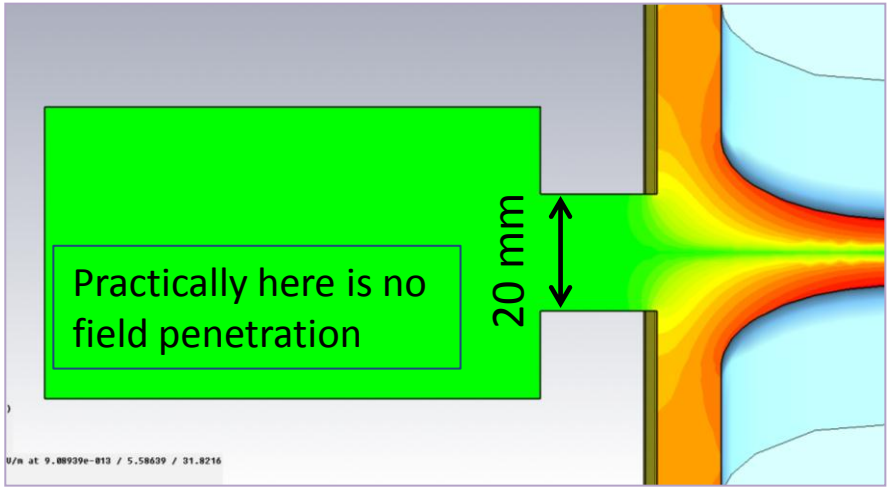
Red – beam from IS (LBNL measurements)
Orange – matched beam at the vane tip plane.

Beam matching is possible without losses, but margins are too tight. Increase of radius r is highly desirable.

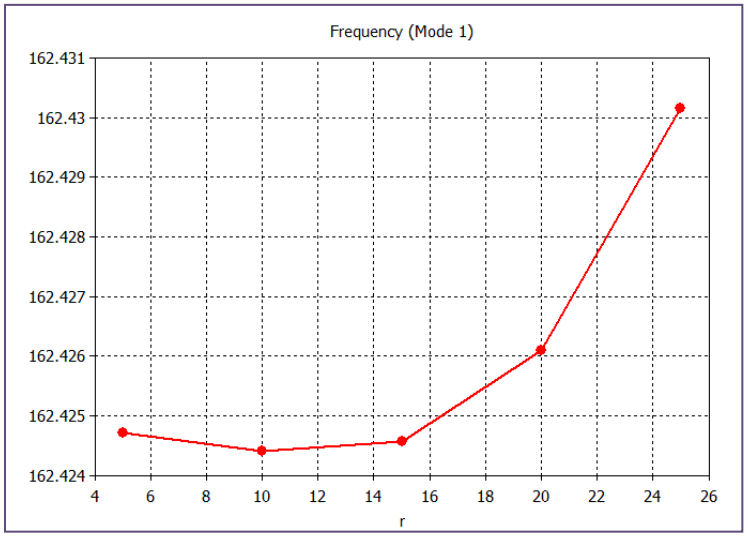
Increased input beam aperture



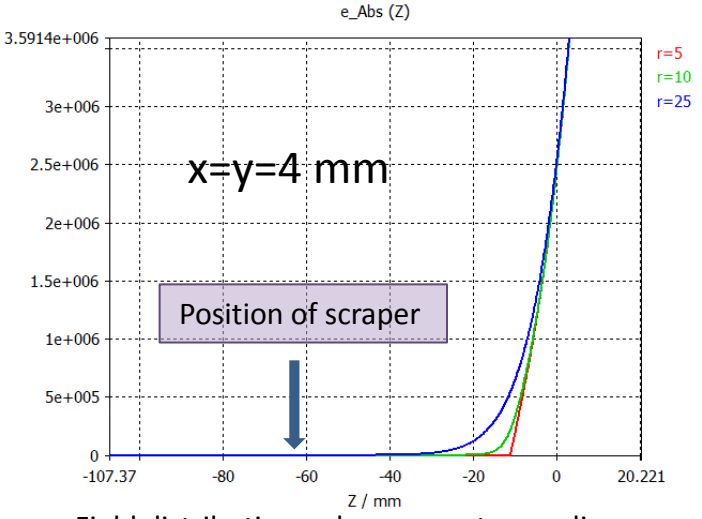
RF model of LEBT-RFQ interface



E field distribution. Logarithmic scale.



Frequency vs beam aperture radius



Field distribution vs beam aperture radius

Short summary

- Generally low fields at the end-walls of RFQs provide relatively low RF losses on the walls and low sensitivity to the mechanical details in the area.
- RF losses are 246 W in the input end-wall and 360 W in the output end-wall (higher because it's closer to the vanes and surface fields are higher)
- End-wall deformations due to the atmospheric pressure cause small frequency shift and absolutely no field distortion (nice feature for fine frequency tuning). For 30 kHz frequency shift limit a steel plate of 5-6 mm would be OK to enforce input end-wall, and 7-8 mm would be OK for output end-wall
- Input beam aperture diameter can be increased up to 50 mm with negligible frequency shift of 10 kHz. Practically there is no field penetration through the beam aperture.